Programming
Remediation and
Intervention for
Students in
Mathematics

PRISM NEO (North Eastern Ontario)

Final Report[1]
May, 2006

Near North District School Board

Simcoe Muskoka Catholic District School Board
Algoma District School Board
District School Board of Ontario North East
Huron Superior Catholic District School Board
Northeastern Catholic District School Board
Sudbury Catholic District School Board
Nipissing Parry Sound Catholic District School Board
North Eastern Ontario School Authorities

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[1] Final report of PRISM-NEO project to the Council of Directors of Education and the Ministry of Education and Training. The views expressed in this report to not necessarily reflect those of the Ministry or CODE. The research team for the project included Ann LeSage and Kelly Anne Smith. Comments about the report should be sent to Dr. Ann LeSage, Nipissing University, North Bay, Ontario, P1B 8L7.

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Context and Purpose of the Study

The PRISM-NEO study was a direct result of the combined efforts of the Mathematics Curriculum Coordinators from the Near North District School Board, the Rainbow District School Board and the Simcoe Muskoka Catholic District School Board to develop a research – based professional development project in support of students at-risk. A partnership then developed between the three lead boards and a researcher from Nipissing University in North Bay. As the project took shape, other North-Eastern Ontario School Boards expressed interest in participation. By commencement of the project, nine District School Boards and one Provincial School Authority were invited to participate.

The primary purpose of the PRISM-NEO project was to provide Grade 7 – 10 mathematics and special education teachers with collegial support and professional development opportunities to assist them in creating appropriate mathematical learning experiences for their students identified as 'at-risk' in mathematics. The PRISM-NEO project attempted to target reforming teachers' mathematics practices and beliefs through combining multiple professional development experiences, including: collegial support within a community of learners from the same school and school board; specific training on the use of the PRIME developmental continuum; opportunities to implement the new knowledge and skills in their current teaching practices; and time to reflect upon their mathematics beliefs and practices, specific to the teaching and learning of their at-risk students.

Theoretical Framework

Teacher Change Processes in Mathematics Education

Since the publication of the Standards2, many studies have provided substantial evidence, which support the positive outcomes of Standards-based mathematics curriculum materials and teaching practices. Specifically, recent studies have provided evidence of improved student achievement and greater persistence in problem-solving, enhanced disposition toward mathematics, increased ability to apply acquired knowledge, and a more thorough understanding of mathematics concepts without the loss of skill proficiency (Boaler, 1993, 1998; Fennema, Franke, & Carpenter, 1993; Romberg, 1997; Schoen & Finn, 2001). However, implementation of mathematics reform practices is a formidable challenge for teachers, as it requires them to undergo substantial changes in both their teaching practices and their beliefs about the nature of mathematics, teaching and learning. This process of re-formation is tenuous and ongoing.

Ross (1999) calls attention to numerous studies that provide consistent evidence on the barriers to reform. He cites the greatest obstacle as incongruous between teacher beliefs and prior experiences with mathematics and mathematics teaching and the assumptions inherent in the Standards. Further to Ross' review of the literature, numerous other studies have supported this hypothesis, and cited additional factors which impede movement toward mathematics reform. Such explanations include, as Ross indicated, previous experiences as students and teachers of mathematics, social teaching norms of the school (including professional development opportunities) and the nature of the immediate classroom situation (LeSage, 1999; Raymond, 1997; Remillard, 1999, 2000; Roulet, 1998). Given the complexity of the interacting components in the reform process, Havelock and Zlotolow (1995) emphasize the importance of providing teachers' with adequate support. They argue that, "without time, money … and personnel, an innovation will have little chance of being adopted, even by a willing and able system" (p. 66).

It follows, therefore, that for teachers to successfully implement a reform-based mathematics practice, it is essential that sustained professional development and adequate support be provided for them. Current research advocates providing support which focuses equally on teaching practice and beliefs about mathematics and mathematics pedagogy (Borko, Davinroy, Bliem, & Cumbo, 2000; Price, Ball, & Luks, 1995). A related body of research contends the importance of providing teachers

[2] Curriculum and Evaluation Standards for School Mathematics by the National Council of Teachers of Mathematics (NCTM, 1989; revised and elaborated 2000).

with opportunities to develop pedagogical content knowledge and deeper conceptual understandings of mathematics (Manouchehehri & Goodman, 2000; Spillane, 2000). Similarly, Ross (1999) suggests that there should “be a dual focus on developing teachers’ disciplinary knowledge and their pedagogical content knowledge” (p. 132).

Although teachers may have well-developed conceptions of mathematics, be knowledgeable about curriculum materials, and hold beliefs about the benefits of Standards-based teaching, they may not possess strong convictions about their ability to implement their ideal mathematics practice. Research has shown that “teacher confidence has a powerful effect on teachers’ willingness to set challenging goals (such as attempting to implement new instructional strategies) and to their willingness to persist through obstacles” (Ross, 1998). Snyder, Bolin and Zumwalt (1992) add that understanding teachers’ characteristics and orientation are also essential components that affect any implementation process. Specifically, they state that “the greater the sense of teacher efficacy, the greater the degree of implementation” (p. 417). To complicate matters further, as teachers attempt to implement new instructional strategies, they may also develop feelings of inadequacy and reduced efficacy because their contribution to student learning is less visible than in traditional teaching (Ross, McKeiver, & Hogaboam-Gray, 1997) or because they experience difficulties in coping with unexpected discussions and challenges that emerge during a lesson (Manouchehehri & Goodman, 2000).

LeSage’s (2005) case study of two grade 8 Ontario mathematics teachers contributed to this research, concluding that the participating teachers’ sense of efficacy and confidence were strong determinants in their willingness to pursue changes in their teaching practice. Moreover, similar to Seifert’s (2004) study of student motivation, LeSage contends that teachers’ past successes and failures with mathematics and mathematics teaching directly impact their self-efficacy beliefs and confidence levels, which in-turn influence which mathematics beliefs they embrace and which actions they enact within their mathematics teaching practice. This assertion is supported by the work of Bandura (1997). He maintains that, “people’s beliefs in their efficacy have diverse effects” on their behaviours (p. 3). He cites the effects of self-efficacy beliefs as influencing: the goals one sets, the changes one pursues, the effort one puts forth, one’s resilience to adversity, one’s willingness to “persevere in the face of obstacles and failures”, how one copes with stressful situations, and “the level of accomplishment” one is able to realize (p. 3).

In summary, teaching is as much an emotional endeavour as it is an intellectual one. This is particularly true for teachers pursuing changes in their instructional practice. Sufficient attention must be paid, as Hargreaves (2001) and Vermunt & Oosterheert (2003) advocate, as much to the technical and cognitive demands of teacher change as to the emotional factors contributing to the teachers’ efforts to reform their practice. If teachers are supported by individual(s) or communities of teachers (Cwikla, 2004) that are passionate about the teaching of mathematics, they may be more likely to become passionate about mathematics themselves. These same individuals or community of teachers may help nurture teachers’ perceived self-efficacy through providing them with classroom technical and emotional supports as they struggle to change their practice. As teachers begin to observe positive changes within their own classrooms, their perceived efficacy will develop or rebound (Ross, 1997).

Finally, and of significance to this study, research has shown that if teachers believe that the changes they pursue are of benefit to their students, affectively and cognitively, they are more likely to continue to pursue these changes in the face of challenges they may encounter along the way (Manouchehri, 2003; LeSage, 2005; Poetter, 1999; Reeder, 2002). Teaching is an emotional practice – one that requires teachers to invest both their hearts and their minds as they pursue the emotional and intellectual work (Hargreaves, 2001) of teaching. Thus through nurturing and supporting teachers’ emotional and intellectual selves, those teachers willing to embrace the effort to change their practice to benefit their students may be more likely to pursue and persist through the obstacles they encounter along their journey.

In order to nurture teachers' emotional and intellectual needs, it is essential to provide appropriate professional development experiences. Previous research studies highlight three characteristics that are likely to encourage teacher change and by extension improved student achievement: instruction and support that goes beyond a one-day or one-week workshop (Lappan, 1997), provision for in-school support for teacher learning and reflection, and simultaneous attention to knowledge development and changing teachers' attitudes and beliefs about mathematics and mathematics pedagogy. However, of specific consideration to the design of this project is the establishment of Professional Learning Communities (PLCs) within each of the participating boards.

Professional Learning Communities

DuFour and Eaker (R. DuFour, & Eaker. R., 1998) describe six characteristics of a professional learning community: a shared mission, vision and values; collective inquiry; collaborative teams; action orientation and experimentation; continuous improvement; and results orientation. However in the Forward of their more recently published collection of works (2005), Mike Schmoker offers a simple explanation which provides the essence of a PLC:

> "The right image to embrace is a group of teachers who meet regularly to share, refine, and assess the impact of lessons and strategies continuously to help increasing numbers of students learn at higher levels." (p. xiv)

Regardless of the definition, a significant amount of research underscores the power of professional learning communities or communities of practice (Wenger, 1998) on teacher change and capacity building, in general (Cochran-Smith, 1999; R. DuFour, & Eaker. R., 1998; R. DuFour, Eaker. R., & DuFour, R., 2005; Fullan, 2001; Lachance, 2003; Seashore Louis, 1998; Wenger, 1998) or mathematics teacher development more specifically (Lachance, 2003; Nickerson, 2005).

Moreover, learning communities established within schools and within boards provide teachers with opportunities to learn and work with colleagues in their own teaching context. Learning in context, also allows teachers to address issues and challenges that are relevant and specific to their school/board situation. Fullan (2001) highlights the significance impact of such design, stating:

> "Learning in the setting where you work, or learning in context, is the learning with the greatest payoff because it is more specific (customized to the situation) and because it is social (involves the group). Learning in context is developing leadership and improving the organization as you go. Such learning changes the individual and the context simultaneously." (p. 126)

Given the challenges inherent in mathematics education reform and the process of teacher change, the benefits of teacher collaboration within a supportive professional learning community are significant and relevant. Promoting the establishment of PLCs, particularly in Northern Ontario school boards, may be viable means for increases successful implementation of mathematics reform initiatives like the PRISM projects.

Students At Risk in Mathematics

> "Math learning difficulties are common, significant, and worthy of serious instructional attention … Students may respond to repeated failure with withdrawal of effort, lowered self-esteem, and avoidance behaviours." (Garnett, 1998)

As a result of repeated failures with mathematics, many students are intimidated by it and, eventually develop a belief that mathematical competency is acquired by only a few gifted individuals. Moreover, these same students view the abstract nature of mathematics as serving no real purpose in their everyday lives. Such experiences result in student frustration and fear/anxiety of mathematics. These negative experiences in the learning process lead to the development of a low perceived self-efficacy; where perceived self-efficacy is defined as a person's belief in his/her own capabilities (Bandura, 1997). Therefore, if a person's past experiences in mathematics are negative and laden with failure, this will result in a lack of confidence in any future encounters with the subject. By contrast, if a person's past mathematical experiences are generally positive, they become efficacious and therefore are more apt to perceive themselves as capable mathematicians. Pajares' (1996) extensive literature review on students' mathematical achievements supports the assertion that students' beliefs about their mathematical abilities are strong predictors of students' future achievements. Students who believe they are capable mathematicians, set challenging academic goals for themselves and tend to persist through external obstacles in order to meet those goals.

However, Seifert's (2004) theoretical study on student motivation asserts that students' self-efficacy beliefs are only one emotional factor contributing to academic behaviours. He contends that in combination with self-efficacy theory, one must consider the emotional interrelationship of attribution theory, self-worth theory, and achievement goal theory. Specifically, self-efficacy theory asserts that students who believe themselves to be capable are more likely to be motivated, while those who believe themselves incapable will not be motivated. However, Seifert highlights two instances in which self-efficacy theory is inadequate. Specifically, it does not account for "bright but bored underachieving student who does the minimum amount of work" to meet some minimal standard. The student may perceive themselves as capable but does not value the task thus exert a minimal amount of effort (p. 144). The second instance Seifert cites is the student that claims s/he is incapable of performing a particular task yet proceeds to complete it successfully. Seifert assets that the child may be "using the claim [of incompetence] as a self-protective mechanism" (p. 144) in order to preserve a sense of self-worth.

Thus, Seifert (2004) offers an alternative perspective to consider which is applicable to our work with students identified as at-risk in mathematics. Specifically, Seifert suggests that we view students' "motivation as an attempt to protect self-worth" (p. 145). Given the intimate connection between self-worth and academic performance, for many students "doing well is important to one's sense of worth and dignity" (p. 145). Thus, if students cannot perform well,

> "… they seek ways to make it appear as though they could have succeeded. In other words, no matter what else occurs, they do not wish to look incompetent. Consequently, if students perceive themselves incapable of performing well (low self-efficacy), they may become motivated to protect perceptions of competency, for if they can convince themselves and others they could do well, they will be able to maintain some sense of worth or dignity." (Seifert, 2004, p. 145)

This development of self-efficacy and protection of self-worth is particularly important during adolescence, as students begin to consider their future career and life paths. However, adolescence can be an emotionally and intellectually difficult transition time. Moreover, adolescents tend to view social connections with peers as a central focus in their personal development (Hewitt, 1995). The enigma of the adolescent is further complicated by the varying stages of individual cognitive development. Many students have not yet transitioned from concrete to formal reasoning; they continue to function at the concrete operational stage of development (Fleener, Westbrook, & Rogers 1995). As a result, it is essential that adolescent learners actively explore, engage in problem solving tasks and work with others in cooperative learning situations (Fleener, et al., 1995). Thus, if socially focused adolescents are provided with the opportunity to interact in positive small group situations to explore interesting, real-life, mathematics tasks, they may begin to develop a stronger sense of self-worth, self-efficacy and confidence in their abilities to do mathematics.

The PRISM-NEO professional development experiences were designed based on these pedagogic beliefs (as this framework is supported within the Thomson Nelson PRIME continua and related research). Moreover, as recommended by the Students at Risk Working Group (O'Connor, 2003), the in-service components of the PRISM-NEO project (i.e., teacher and administrative workshops, the establishment of professional learning communities within local schools, and the creation of a supportive network within the family of schools) were structured to "build the confidence level of teachers in grades 6 to 8 to support at-risk students" … and foster the belief that "all teachers can make a difference for at-risk students" (p. 25).

Research Questions

With the release of the Ontario Ministry of Education documents: Building Pathways to Success (2003), Leading Math Success (2004) and Education for All (2005) there has been an increased awareness of the importance of developing and delivering specific interventions to support improved achievement for Grades 7 – 10 students identified as at risk in mathematics. Thus, the research questions for this study address questions directly related to specific interventions and professional development strategies aimed at supporting the teaching and learning of mathematics for students identified as at-risk. The research questions include:

1. How does explicit instruction on the use of a research-based mathematics resource, such as the Nelson PRIME developmental continuum, combined with a supportive collaborative school community influence teachers' conceptions of mathematics and mathematics pedagogy, their teacher efficacy and their confidence in mathematics, specific to their efficacy with at-risk students?
2. In what ways do teachers perceive improvement in the knowledge and skills of their at-risk students through the use of the Nelson PRIME developmental continuum?
3. How does implementation of the Nelson PRIME developmental continuum influence teachers' practices, specifically with respect to their efforts to differentiate instruction and develop appropriate instructional and assessment tasks for their at-risk students?
4. What do teachers identify as the affective and cognitive benefits of providing at-risk students with take – home CDs containing Geometers Sketchpad software and related sketches? Does this resource influence students' mathematics efficacy?
5. What do teachers and principals identify as factors inhibiting and supporting their efforts to improve their mathematics teaching practices for students identified as at-risk in mathematics?

Methodology

Study Participants

The PRISM-NEO participants were a purposeful sample of teachers and administrators from nine North-Eastern Ontario school boards and one School Authority that expressed interest in the project. The project involved approximately 57 Teachers (Grades 6 – 10), 10 Resource Teachers, 20 Math Leads/Curriculum Coordinators/Student Success Leads, 17 Principals, and 105 Students (Grades 6-10). Selection criteria varied within each region, however each board was asked to select: one special education teacher, one or two grade 7/8 teachers and one principal (from the same school) and one or two grade 9 or 10 teachers from a near-by high school to create a "family of schools" within their board. Each family of schools constituted a professional learning community (PLC). The teacher participants were asked to select appropriate student participants. The selection process varied depending on the goals of the board. However, regardless of the number of students involved within each board, the minimum selection criteria included students that were characterized as "at-risk" and generally had a good record of attendance.

Data Collection Instruments

The data collection instruments utilized in this study included two self-assessment surveys: a mathematics teaching practices survey and a web site self-assessment; a teacher efficacy questionnaire; a teacher feedback questionnaire; semi-structured focus group interviews with families of schools and math facilitators in each board; electronic interviews with the seven smaller participating boards; classroom observations; artefacts (e.g., assessment tasks, lesson plans, teachers' anecdotal notes and board PLC agendas); and quantitative and qualitative data from the student participants. Most data was collected from May 2005 until January 2006; however some boards continued to provide data until February 2006.

The quantitative and descriptive data obtained from the survey responses served as a point of departure in collecting qualitative data from the participants. Given the assertion that beliefs are not easily articulated, it is important that evidence include more than the analysis of data collected based on articulation of professed beliefs. The research literature on beliefs-practice investigations rely on at least two of three primary data sources: questionnaires (generally related to beliefs and practice), open-ended interviews, and classroom observations (Thompson, 1992).

The qualitative data was collected from a variety of sources at varying times throughout the research project. The information was used to validate quantitative findings. The qualitative data analysis contributed directly to developing an understanding of how the PRISM-NEO initiatives were enacted in the classroom by focusing attention on the ways in which the participants interpreted and enacted instructional improvement efforts.

Treatment Design

The PRISM-NEO project provided three days of Nelson PRIME Teacher training for all teacher participant (including Resource teachers and Lead Instructors) and two days of Nelson PRIME Administrative training for all principals and/or other board administrators. The PRIME Teacher training focused on the development of teachers' mathematical content knowledge as well as pedagogical content knowledge. Three one-day workshops were offered by Thomson Nelson staff over a number of weeks, beginning in May 2005 and ending in August 2005. The principals and board administrators were offered the two-day Administrator Professional Learning Program in May 2005. To further support each learning community, participating teachers and principals were provided with opportunities to meet and discuss their classroom experiences between PRIME training sessions and throughout the duration of the project (e.g., through release time).

In July 2005, some participating PRISM-NEO teachers, together with provincially recognized Sketchpad experts developed student-friendly GSP sketches which address students' conceptual difficulties as identified during the project. The purpose of creating and revising GSP sketches is to provide students with an alternative means for exploring specific concepts as they develop conceptual understanding through the use of technology – one of the instruments of what the Notable Strategies Conference material would refer to as *instructional jazz.*

Throughout the fall of 2005, the professional learning communities met. The number of meetings depended on the schedule of the teachers within each of the boards. However, for the three Lead Boards each PLC meeting was facilitated by the respective Math Consultants. Data collection continued in the form of observation notes from the Lead Board PLC meetings, focus group interviews during the PRIME Facilitator Training in November 2005, email communications with teachers and principals, focus group interviews with the three Lead Boards in November/ December 2005, re-administration of the teacher surveys, as well as student exit interview data, student feedback questionnaire and student scores from the pre and post-test administration of the Nelson PRIME Numbers Diagnostic and the Operations Diagnostic Tool F.

Reliability and Validity of the study
The internal validity of a quantitative study is generally strongest when the "study's design effectively controls possible sources of error so that those sources are not reasonably related to the study's results" (McMillan, 1994), p. 183). Possible sources of error include: history threats and subject effect threats. Specifically, any participant change could be, in part, impacted by uncontrollable extraneous incidents external to the project (e.g., other provincial initiatives, school and classroom context; personal factors, etc.).

While there was no control group in the PRISM-NEO study, a blended research design controlled possible sources of error, to improve the study's validity and reliability. Through combining broad quantitative data analysis with detailed qualitative analysis, the findings from each were triangulated, resulting in greater reliability and validity. Specifically, validity and reliability were addressed throughout the multiple phases of the qualitative research component of the project: from the conceptualization of the study, to the data collection techniques, the modes of data analysis and interpretation, and finally the manner in which the research is presented (Merriam, 1998).

Results and Discussion

The Students' Perspective
Influence of the PRISM-NEO Project on Student Attitudes and Beliefs
The students' qualitative data were obtained from two sources: a student attitude survey and a student exit interview (see Appendix). Although this section outlines the influence of the PRISM-NEO project on student attitudes and beliefs, its primary purpose is to provide information concerning how at-risk students perceive mathematics; their ability to learn mathematics; and their frustrations with the learning process. Thus, this section of the report provides an assessment of students' needs for the purpose of planning future interventions for at-risk students. Thus, the question addressed in this section is: What can students identified as at-risk in mathematics teach us about their experiences in mathematics that will help us improve teaching for this group of students?

The sixteen item Likert survey questions are structured in such a way as to delineate students' attitudes and beliefs within four broad categories: importance and relevance of mathematics; efficacy and confidence in mathematics abilities; the role of rules and explanations; and communication and learning supports. The student attitude survey, modified from (D. Siemon, Virgona, J. & Corneille, K., 2001a), asked student participants to indicate the degree to which they agreed or disagreed with statements specific to attitudes and beliefs about mathematics. Aggregated percentages, summarizing the degree to which participants agreed or disagreed with each statement, are shown in the shaded cells in Table 1 below (N = 47; with 45% return rate).

The student exit interview was conducted by the participating teachers with their respective student participants. The interview focused on students' perceptions of change (cognitive and affective) as a result of involvement in the PRISM-NEO project. Additionally, the interviews garnered student feedback with respect to mathematics topics or concepts identified as problematic; and effective teaching strategies for students identified as at-risk in mathematics.

Of the forty-seven students that completed the survey, 22 were female and 25 were male. The following table shows the grade level distribution by gender.

	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10
Male	1	8	11	2	3
Female	1	6	15	0	0

Of the forty-seven students that completed the survey, 19 were interviewed from six of the ten participating boards. Although all teachers were asked to conduct exit interviews with their students, logistics and narrow time frames made it difficult. The following table shows the grade level distribution by gender of interviewed students. In eight cases, the students' grade level and/or gender were not provided.

	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	No Grade
Male	1	1	2	1	1	1
Female	1	1	3		1	1
No gender		1	2	1	1	1

Table 1.
PRISM-NEO Student Attitude Survey

	SD	D			A	SA
1. Mathematics is not as important as some people think	30	32	21	9	4	4
		83%			**17%**	
2. If I could get out of doing one subject it would be math	26	21	19	15	2	17
		66%			**34%**	
3. Most of my friends are better at math than me	6	15	11	26	23	19
		32%			**68%**	
4. Math is hard	11	13	15	30	21	11
		39%			**62%**	
5. Math is my best subject	50	22	9	11	2	7
		81%			**20%**	
6. To be good at math you just need to do what the teacher tells you to do	9	21	26	21	15	9
		56%			**45%**	
7. Mathematics is easy if you know the rules	4	13	13	13	28	19
		30%			**70%**	
8. People who have a calculator or a computer don't need to learn as much math	60	28	9	2	0	2
		97%			**4%**	
9. We learn a lot of things in math classes that we'll never use outside of school	40	17	13	23	0	6
		70%			**29%**	
10. I can do math but find it hard to explain what I've done	9	11	17	32	21	11
		37%			**64%**	
11. Sometimes I just know the answer but I don't know how to do it	15	9	2	34	28	13
		26%			**74%**	
12. Math is good when the teacher goes slowly	6	9	13	19	17	36
		28%			**72%**	
13. I like it when the teacher explains things to me by myself	4	11	2	13	30	39
		17%			**82%**	
14. If I don't understand what the teacher` has explained I ask for it to be repeated.	6	6	11	19	36	21
		23%			**76%**	
15. If I don't understand what the teacher has explained I ask a friend to help me.	9	6	4	30	32	19
		19%			**81%**	
16. If I don't understand what the teacher has explained I just forget about it	43	15	11	23	4	4
		69%			**31%**	

Mathematics as Important and Relevant

In spite of the historical difficulties with learning mathematics, an overwhelming majority of the PRISM-NEO students indicated that math was important, significant and relevant to their lives outside of school. Although 34% would avoid mathematics classes if possible, the remaining 67% of the students believed that mathematics is important and they would continue to enrol in math, even if it was not a required course of study.

Questionnaire Statement:	Agree	Disagree
1. Mathematics is not as important as some people think	12 %	86 %
2. If I could get out of doing one subject it would be math	34 %	67 %
8. People who have a calculator or a computer don't need to learn as much math	4 %	96 %
9. We learn a lot of things in math classes that we'll never use outside of school	31 %	69 %
16. If I don't understand what the teacher has explained I just forget about it	32 %	67 %

Also of interest, and perhaps a sign of the pervasive use of technology in mathematics, was the 96% disagreement that calculators and computers will act as a replacement for learning mathematics. Thus, from the students' perspective they do not view the use of calculators and/or computers as a replacement for mathematics learning or fact mastery.

Student Efficacy and Confidence in Mathematics Abilities

Given the sample population, it is not surprising that most students indicated that they struggle with mathematics (62%) and they generally regard themselves as unsuccessful when compared to their peers (68%). Although not prevalent in the student interview data, four of the nineteen students interviewed highlighted their lack of confidence as mathematics learners. Two students offered generalized statements, including; "I'm not good in math" (B01-S01[3]) and "[it is the] numbers … I just don't get math" (B02-S02). While another student acknowledged discontent, stating "[I feel frustrated] when I think it is [already] so hard and it will only get harder" (B01-S02). Finally, one student references the specific PRISM-NEO experience, stating, "I learned nothing [from this project]. I'll never learn math" (B02-S01).

Questionnaire Statement:	Agree	Disagree
3. Most of my friends are better at math than me	68 %	32 %
4. Math is hard	62 %	39 %
5. Math is my best subject	20 %	81 %

However, of greater interest is the approximate one-third (1/3) of the sample population who believed the contrary. Specifically, these students considered themselves more able in mathematics than their peers (32%) and did not regard mathematics as a difficult subject (39%). The question thus becomes: If it is not low self-efficacy beliefs, why then are these students at-risk of failing mathematics? The qualitative analysis of student interview data provides two possible explanations to this query: students' deficiency in both procedural and conceptual understandings, and a disparity between the dominant teaching methodologies and the students' preferred learning styles.

In particular, students acknowledged a lack of operational sense with both whole numbers and integers. One student stated, "Division confuses me. Multiplication doesn't; just division" (B01-S03). However, most of the PRISM-NEO student participants struggled predominately with number sense and operational sense with rational numbers. This data emerged from the first administration of the PRIME Diagnostic tools (Numbers and Operations Tool F), and thus became the primary instructional focus for the majority of the participating boards. Consequently, when students were asked to comment on their key learning outcomes as a result of participation in the PRISM-NEO project, they emphasized identifying and comparing fractions (as part of a whole and part of a set), fractional equivalency (including converting improper fractions to mixed numbers), operations with fractions and converting fractions to decimals and percentages. Nonetheless, when asked to identify areas in mathematics in which they would like additional assistance, almost half of the interviewed students (8 out of 19) identified either fractions or operations, in general. This data indicates that although the intervention yielded positive learning outcomes for many students, they continue to request additional time and support in both identified areas. One teacher explains that the at-risk

[3] The codes identify the Board number (B01); the Student number (S01); and the Teacher number (T01).

students' learning situation is complex, as many students lack operational sense with whole number, thus the complexity of operations with fractions is overwhelming for them. She describes one of her students as feeling defeated because "she lacks basic skills … [her] weakness with simple algorithms (+, −, x, ÷) … makes it difficult [for her] to do something [as simple as] finding common denominators" (B10-T01).

The second prevailing theme to emerge from the interviews as a possible explanation for student failure in mathematics is the apparent disparity in teaching and learning styles. The dominant teaching methodologies employed in many mathematics classrooms do not address the students' particular learning needs. Specifically, fourteen of the nineteen students interviewed addressed this disparity in some form. Generally, students highlighted the difficulties they encounter when required to be passive participants in mathematics classes that focus on note taking, textbook questions, working in isolation, and racing against an academic clock. Students verbalize their frustration when mathematics is presented as "just on the board and answering questions" (B02-S02) and express discontent and isolation "when the teacher says: *'Figure it out'*" (B01-S03). Many students also struggle with current textbooks, with respect to the math content and reading levels. They also describe textbooks as confusing and deficient in appropriate explanations and examples. Moreover, students express frustration with the breadth of content in the textbooks, stating that "[there is] not enough time to work through" them (B02-S02). Moreover, students often feel pressured to meet curricular expectations on someone else's agenda. Specifically, one student states that "you feel like you don't have enough time to get the Math done (B06-S01), while another recommends that they might meet with greater success if "the course [were] slowed down … there is too much "stuff" at once" (B02-S01).

Reliance on Rules and Explanation

Perhaps not surprising, given their experiences with traditional mathematics pedagogy, the majority of the students seem to adhere to a more traditional view of mathematics, as rule driven and memorization focused, with 73% indicating that success in mathematics is directly related to memorization of rules and procedures. Moreover, almost half of the students (47%) tend to regard learning mathematics as a passive endeavour, with learning directly related to following the teachers' instructions and directions. At the same time, however, the students acknowledge that communication of their mathematical knowledge is an ongoing challenge and may be a salient factor in their mathematical struggles.

Questionnaire Statement:	Agree	Disagree
7. Mathematics is easy if you know the rules	73 %	26 %
11. Sometimes I just know the answer but I don't know how to do it	73 %	27 %
10. I can do math but find it hard to explain what I've done	62 %	38 %
6. To be good at math you just need to do what the teacher tells you to do	47 %	54 %

Communication and Support

The data above (Questions 10 and 11, specifically) suggests the significant influence of communication in student learning, success and level of engagement. If one is unable to explain their mathematical processes and thinking, they are less likely to engage in classroom dialogue and may, instead chose to disengage.

The significance of the communication component of mathematics learning for students' at-risk is underscored by the responses below. Specifically, 71% indicated an increased understanding when the teacher proceeded at a slower pace; thus implying that students require more time to process new information. Moreover, an overwhelming majority of students indicated that they regularly seek assistance or clarification from the teacher (75%) or more able peers (82%) when they do not understand the lesson content. Finally, and of significance to the PRISM-NEO project, 82% of the student respondents indicated that they benefit from the one-on-one time spent with their teachers.

Questionnaire Statement:	Agree	Disagree
12. Math is good when the teacher goes slowly	71 %	29 %
13. I like it when the teacher explains things to me by myself	82 %	18 %
14. If I don't understand what the teacher has explained I ask for it to be repeated.	75 %	25 %
15. If I don't understand what the teacher has explained I ask a friend to help me.	82 %	17 %

The value of communication, the quality of teacher explanations and one-on-one support were dominant themes to emerge from both the student and the teacher exit interviews. Furthermore, all of the students interviewed underscored the significant learning that resulted from their small group or one-on-one sessions that focused on the use of manipulatives, diagrams, and purposeful conversations set in a risk-free environment. These small group situations allowed students the freedom to actively explore, ask questions, and develop mathematics confidence and competence. Students and teachers recognized the significant impact of utilizing manipulatives and diagrams as a means for exploring math content and serving as a bridge for the development of students' communication skills and confidence. One student explains, "When I am writing, I get confused and usually fall behind. [But when] using manipulatives…I can see how things [are modelled] and can then work it out in my head" (B02-S03). Students also focused on the centrality of teacher explanations and modelling; expressing their appreciation for the teacher taking time to "do as many examples as needed to understand" (B01-S01). Another student clarifies, "I need visual experience and having it explained in more than one way. The more I see it, the better it is" (B02-S02).

The PRISM-NEO teachers reiterated the students' responses. Specifically, the teachers highlighted the value of the manipulatives and diagrams in providing the students with a means of expressing their ideas and developing their mathematical language and confidence. One teacher asserted that the manipulatives provided her students the opportunity to demonstrate their understanding "and from the hands-on demonstration … flowed the language to talk about the topic" (B01-T02). While, another teacher corroborates, stating "I believe that the activities involving manipulatives allowed the students to get away from pencil-paper [tasks] and [allowed them] to feel as if they could understand the material in a new way. [It] showed them that there is more to math than number crunching … and that is important" (B04-T01).

Finally, one high school teacher describes the influence of a PRISM-NEO intervention which focused on manipulative-based activities and the development of effective communication skills set in a risk-free environment:

> "I [have] witnessed two students who had no confidence in themselves … gain some self-confidence. Once they realized that they have the ability, they had fun with the math. … We now have had more conversations in the hallways, as they seem to feel more comfortable approaching me about a range of topics. … Their [improved] attitudes/confidence indicators would be level of voice, body language, rapport during non-instructional times, and increased level of participation during whole group and small group learning times. … They now [believe that they] have the ability to learn concepts that they [previously] thought of as too difficult or confusing." (B02-T01)

Summary of Findings: Student Attitudes and Beliefs

The primary purpose of this section of the report was to address the question: What can students identified as at-risk in mathematics teach us about their experiences in mathematics that will help us improve teaching for this group of students?

The survey findings and the student exit interviews indicate that, from the students' perspective, they are cognizant of their learning difficulties in mathematics. Yet, in spite of their negative histories with the subject, they view it as significant and relevant to their daily lives and their futures. The findings suggest that the students at-risk are not disengaged learners; they accept some responsibility for the learning process through their willingness to obtain support from either the teacher or their peers. Moreover, the students attribute some of their difficulties in learning mathematics to their inability to communicate mathematically, either verbally or in written form. These findings suggest that students at-risk in mathematics would benefit from additional instructional time; one-on-one assistance with either a teacher or more able peer; and manipulative-based activities focused on developing conceptual and procedural knowledge as well as mathematics communication skills.

The student attitudinal findings from the PRISM-NEO study are consistent with the attitudinal findings from the large scale Australian Middle Years Numeracy Project (D. Siemon, Virgona, J., and Corneille, K., 2001). Although the student participants were from opposite hemispheres, they reported very similar internal and external factors contributing to their struggles with mathematics. Moreover, their recommendations to improve their learning experiences were also markedly similar. For example, both groups of at-risk students suggested more one-on-one support; better quality teacher explanations; less reliance on traditional textbook driven lessons; and additional assistance in improving their deficiencies in fundamental mathematics knowledge (i.e., basic operations with whole numbers and fractions; and identifying, describing and comparing fractions). Finally, a salient theme in both groups of students was their desire to learn mathematics, as they perceived it as significant and relevant to their lives and future success.

Influence of PRISM-NEO project on Student Achievement

In addition to the qualitative data which focused on the affective outcomes of the PRISM-NEO project, quantitative data was obtained to measure changes in student achievement over the brief intervention time frame. A paired sample t-test was conducted on all participating students' PRIME raw scores for both the Number and Operations Diagnostics (Diagnostic Tools F; Maximum score = 28). The results indicate that the PRISM-NEO project had a significant effect on students' Number and Operations knowledge. As illustrated in Table 2, there was a significant increase in both Number and Operations scores from pre-test to post-test. However, in the absence of a control group these results should be viewed judiciously.

Table 2.
Effects of PRISM-NEO on Student PRIME Diagnostic Raw Scores

	Pre-test			**Post-test**			**t-test results**
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**[t(df) =, p =]**
Number Diagnostic	73	15.75	5.03	73	18.73	4.93	t(72) = - 6.78, p < .001
Operations Diagnostic	28	16.11	5.82	28	18.39	5.66	t(27) = - 2.72, p = .011

Correlation coefficients were also computed among six student variables (gender, grade level, and pre-test/post-test PRIME scores for the Number and Operations Diagnostics) to determine if significant relationships (correlation is significant at the 0.05 level) existed among the variables. The results of the correlation analysis are presented in Table 3.

Table 3.
Correlations Showing Relationships among Student Variables

		Gender	Exceptionality	Grade Level	Number F-pre-test	Number F-post-test	Operations F-pre-test	Operations F-post-test
Gender	Pearson Correlation		.222	.265(*)	-.218	-.246	.184	.333
	N		65	65	65	63	31	28
Exceptionality	Pearson Correlation			.466(**)	-.361(**)	-.383(**)	.(a)	.(a)
	N			95	75	73	31	28
Grade Level	Pearson Correlation				-.201	-.354(**)	.242	.405(*)
	N				65	63	31	28
Number F-pre-test	Pearson Correlation					.717(**)	.665(**)	.652(**)
	N					73	29	27
Number F-post-test	Pearson Correlation						.665(**)	.652(**)
	N						29	27
Operations F-pre-test	Pearson Correlation							.700(**)
	N							28

(*) Correlation is significant at the 0.05 level (2-tailed).
(**) Correlation is significant at the 0.01 level (2-tailed).
(a) Cannot be computed, as the Operations Diagnostic was not administered.

The analysis revealed significant positive correlations between the pre-test and post-test PRIME Diagnostic scores for both the Number Diagnostic and the Operations Diagnostic. Specifically, the Number Diagnostic pre-test positively correlated with the Number Diagnostic post-test ($r = .717$, $p < .001$), the Operations Diagnostic pre-test ($r = .665$, $p < .001$), and the Operations Diagnostic post-test ($r = .652$, $p < .001$). In general, the results suggest that if students' scored well on the Number Diagnostic pre-test, they tended to score well on the remaining three Diagnostic tests. Similarly, a significant positive correlation was revealed between the Number Diagnostic post-test and the Operations Diagnostic pre-test ($r = .665$, $p < .001$) and the Operations Diagnostic post-test ($r = .652$, $p < .001$). Finally, student scores on the Operations Diagnostic pre-test positively correlated with their scores on the Operations Diagnostic post-test ($r = .700$, $p < .001$).

The analysis also revealed a significant negative correlation between grade level and PRIME Number Diagnostic post-test scores ($r = -.354$, $p = .004$). Thus, for this sample population, post-test PRIME Number Diagnostic scores decreased as grade level increased. This pattern is apparent in Table 4 below, which summarizes the means, standard deviations, and t-tests by test occasions for the Number and Operations PRIME Diagnostics by grade level and exceptionality. The analysis indicates that students in the lowest grade level scored highest in both pre-test and post-test scores for the PRIME Numbers Diagnostic. However, this negative correlation seems to be more a product of sample size and sample characteristics than true grade level abilities. Specifically, the lower grades (Grades 7 and 8) had significantly more students completing the diagnostic, and of these students, only small percentages were (IEP) identified. By contrast, of the six students in grades 9 and 10 to complete the diagnostic, four were identified. Note however, that the paired sample t-test results, as illustrated in Table 4, indicate that there was a significant increase in PRIME Number scores for all grade 7 students (both non-IEP and IEP); and a significant increase in PRIME Operations score only for Grade 7 non-IEP students.

Table 4.
Effects of Intervention on PRIME Diagnostic Scores by Grade Level and Exceptionality

Grade Level	**Exceptionality**		**Number F-pre-test**	**Number F-post-test**	**Operations F-pre-test**	**Operations F-post-test**
7	N/A	N	35	35	26	26
		Mean	17.66	21.20	15.69	17.77
		Std. Deviation	4.83	4.51	5.84	5.36
		t-test results	t(34) = - 5.88, p < .001		t(25) = - 2.33, p = .028	
	IEP	N	6	6		
		Mean	11.50	15.33		
		Std. Deviation	3.73	2.07		
		t-test results	t(5) = - 3.07, p = .028			
8	N/A	N	12	12	2	2
		Mean	15.92	17.33	21.50	26.50
		Std. Deviation	5.08	4.76	.71	2.12
		t-test results	t(11) = - 1.33, p = .209		t(1) = - 5.00, p = .126	
	IEP	N	4	4		
		Mean	12.00	18.00		
		Std. Deviation	3.56	6.06		
		t-test results	t(11) = - 1.33, p = .209			
9	N/A	N	2	2		
		Mean	16.00	16.00		
		Std. Deviation	.00	5.66		
		t-test results	t(1) = .00, p = 1.00			
10	IEP	N	4	4		
		Mean	13.00	14.75		
		Std. Deviation	4.24	1.70		
		t-test results	t(3) = -1.70, p = .188			

A negative correlation was also revealed between exceptionality and pre and post-test PRIME Number Diagnostic scores. Specifically, negative correlations were noted between student exceptionality and pre-test Number Diagnostic scores (r = -.361, p = .001) and post-test Number Diagnostic scores (r = -.383, p < .001). This finding indicates that identified students (IEP) scored lower on both pre and post-test Number Diagnostics than did non-identified students. Although this finding is not surprising, upon closer examination of the data (Table 5) it is apparent that the mean differences on the pre-test and post-test Numbers Diagnostic for the non-IEP students is only slightly greater (by 0.12 points) than the mean difference for the identified students. Thus, it seems that both IEP and non-IEP students benefited from the PRISM-NEO intervention, however as indicated previously, the differences are statistically significant only for the grade 7 students [due to sample size].

Table 5.
Descriptive Summary of PRIME Scores by Exceptionality

Exceptionality		Number F-pre-test	Number F-post-test	Mean Difference	Operations F-pre-test	Operations F-post-test	Mean Difference
N/A	N	57	57		28	28	
	Mean	16.72	19.72	3.00	16.11	18.39	2.29
	Std. Deviation	5.01	4.70		6.132	5.659	
	t-test results	t(56) = -6.07, p < .001			t(27) = -2.72, p = .011		
IEP	N	16	16				
	Mean	12.31	15.19	2.88			
	Std. Deviation	3.40	4.12				
	t-test results	t(15) = -2.94, p = .010					

In addition to the influence of the PRISM-NEO intervention on participating student achievement, the analysis also revealed an overall positive influence of the project on non-participating PRISM-NEO students. In particular, the Rainbow District School Board provided the researcher with student data from all of the participating teachers' regular classroom students (N = 141). This additional data provided insight into the influence of teacher participation on both the PRISM-NEO students and the regular classroom population. Specifically, the twenty PRISM-NEO students [eight IEP] that the Rainbow DSB teachers worked with, one-on-one or in small group instruction, exhibited significant changes in their pre-test and post-test PRIME Number Diagnostic scores (mean difference = 2.90; t(19) = -3.71, p = .001). Furthermore, as illustrated in Table 6 below, the data also revealed significant increases in PRIME Number Diagnostic scores for the general population of students (mean difference = .94) and the IEP student population (mean difference = 2.19) in which the PRISM-NEO teachers interacted with on a regular basis. Although the mean difference in pre and post-test scores of the non-participating IEP student population (2.19) was slightly less than the mean difference of the participating IEP student population (2.88), it is of consequence to this study. These findings seem to indicate that the PRISM-NEO teacher participants' utilized information and knowledge gained from their professional development experiences and their work with individual PRISM-NEO students to inform their regular instructional practices. Unfortunately, in the absence of a control group, these findings cannot account for changes in student achievement that may be caused by factors external to the PRISM-NEO intervention (e.g., maturation, cognitive development, etc.).

Table 6.
Effects of the PRISM-NEO Intervention on Non-participating Students (Rainbow DSB)

PRIME Number Diagnostic	Pre-test			Post-test			t-test results
	N	Mean	SD	N	Mean	SD	[t(df) =, p =]
All Students	141	19.42	4.58	141	20.35	4.17	t(140) = -3. 85, p < .001
IEP Students	26	15.73	4.16	26	17.92	4.24	t(25) = -3.27, p = .003

Summary of Findings: Student Achievement

The pre- and post-test PRIME Diagnostic data provides additional insight into the effects of the PRISM-NEO intervention on both participating and non-participating students. Specifically, the data indicates that the PRISM-NEO intervention had a positive influence on participating students' Number and Operations knowledge. Moreover, the Rainbow District School Board data reveals the significant effect of the project on participating teachers' regular mathematics practices. However, it is important to remember that these conclusions are based only on data obtained from participating teachers' classrooms. In the absence of a control group for comparison, it is difficult to conclude with certainty that the PRISM-NEO student achievement results would be significantly different than student achievement results from non-participating teachers' classrooms.

Although the findings are positive and encouraging, of some concern to regular classroom teachers is the limited number of students (N = 12 or 11.4%) that reached Phase 5 (Flexible Thinking Phase) or Phase 4 (More Abstract Phase) (N = 28 or 26.6%) in their post-test Number Diagnostic scores. The post-test mean scores from the paired sample t-test for both the Number Diagnostic and the Operations Diagnostic were approximately 18.5, indicating that the majority of Grade 7 – 10 students at-risk in the PRISM-NEO study scored Phase 3 in their number sense development. According the Nelson PRIME *Guide to Using the Developmental Map* this correlates to students in Grades 3 – 5 (p. 12). The primary explanation for this Phase assignment is that relatively few of the participating students are facile with fractions and decimals nor operations with either. Thus, additional support and time is required to provide students with the requisite skills and understandings they are lacking in fractions and decimals.

Conclusions

<u>From the Students' Perspective</u>

The analyses of students' achievement data indicate that there was a significant program effect on students' understanding of numbers and operations for IEP and non-IEP students, and for both participating and non-participating students.

The analyses of students' attitudinal data suggests that students at-risk in mathematics would benefit from additional instructional time; one-on-one assistance with either a teacher or more able peer; and manipulative-based activities focused on developing conceptual and procedural knowledge as well as mathematics communication skills. Thus, the PRISM-NEO findings support the creation of a mathematics learning environment that balances both small group collaboration and teacher directed explicit instruction provided to at-risk students either one-on-one or in homogeneous small groups. A collaborative environment, with appropriately scaffolded activities, allows students to function within their "zone of proximal development" (Vygotsky, 1978), improve their communication skills, and expand their understanding of mathematics. The one-on-one or small group explicit instruction provides students with the opportunity to develop their confidence and competence in mathematics through observing the teacher or peers model strategies and effective communication, as well as allowing students to more freely explore with manipulatives, ask questions, and review or practice specific concepts and/or skills.

<u>The Teachers' Perspective</u>

Influence of the PRISM-NEO project on Teacher Efficacy

Although teachers may have the benefit of strong disciplinary and pedagogical content knowledge, espouse reform beliefs about the nature of mathematics, and retain beliefs about the advantages of a Standards-based teaching practice, they may not possess confidence in their ability to implement reform mathematics practices. Teacher confidence in their teaching abilities is an element of teacher efficacy. Teacher efficacy can be defined as teacher's beliefs in their capabilities to organize and execute teaching actions required to bring about student learning. Teacher efficacy is a strong determinant of classroom practice, as it partly determines how teachers "structure academic activities in their classrooms and shape students' evaluations of their intellectual capabilities"

(Bandura, 1997), p. 240). Specifically, teachers' efficacy beliefs influence the changes one pursues, the effort one puts forth, one's resilience to adversity, one's willingness to "persevere in the face of obstacles and failures", how one copes with stressful situations, and the "level of accomplishment" one is able to realize (Bandura, 1997, p. 3). Given this assertion, exploration of the influences of the PRISM-NEO project on teachers' efficacy is an integral component of the data analysis.

Quantitative Data Analysis Results

A paired sample t-test was conducted to evaluate the influence of the PRISM-NEO project on the three teacher efficacy variables: Student Engagement, Instructional Strategies and Classroom Management. The results indicated that the PRISM-NEO project had a significant effect on teachers' beliefs about their capacity. As illustrated in Table 7, there was an increase in all three teacher efficacy measures from pre-test to post-test; yet, the difference was statistically significant on only two variables: Student Engagement and Instructional Strategies. These findings are of consequence, given the project's focus was on task development and instructional strategies. By contrast, none of the PRISM-NEO project goals focused on classroom management.

Table 7.
Effects of PRISM-NEO on Teacher Efficacy: Means, Standard Deviations, and t-tests by Test Occasion

Teacher Efficacy Scale	Pre-test			Post-test			t-test results
	N	Mean	SD	N	Mean	SD	[t(df) =, p =]
Student Engagement	47	6.46	1.08	47	7.08	1.12	$t(46) = -4.19, p < .001$
Instructional Strategies	46	7.23	.97	46	7.57	.95	$t(45) = -2.29, p = .027$
Classroom Management	45	7.63	.92	45	7.86	.91	$t(44) = -1.47, p = .148$

Given the significant differences in teacher efficacy pre-test and post-test, demographic variables were examined to determine if teacher background influenced the degree to which participants benefited from the PRISM-NEO project. Thirteen demographic variables were first correlated with the pre and post-test teacher efficacy measures. ANOVAs were then produced for the five correlations that were identified as statistically significant: Gender, Age, Years Teaching at the Intermediate Level, Last Mathematics Course, and Enrolment in University Mathematics Courses. However, only one of the demographic variables, Gender, produced a significant ANOVA. The most likely explanation for this being that the correlational analysis involved a large number of tests; with an alpha level of .05 you would expect that one in twenty would reach statistical significance through chance.

Thus, based on the quantitative data analysis, the PRISM-NEO project seems to have had an equally significant influence on the efficacy beliefs of all participants regardless of demographic variables. Thus, one can conclude that the participants are more confident in their teaching now than they were prior to the commencement of the PRISM-NEO project.

Influence of PRISM-NEO project on Teachers' Self – Reported Practices and Knowledge

In addition to exploring the influence of the PRISM-NEO project on teacher efficacy, we also wanted to compare the degree to which the project influenced teachers' self-reported mathematics teaching practices. Thus, a paired-sample *t*-test was conducted on the means for the 20-item survey measuring teachers' self-reported mathematics teaching practices (see Table 8). The results indicate that the mean for post-test teaching practice was significantly greater than the mean for the pre-test teaching practice. Thus, there was a statistically significant increase in teachers' self-reported practices. The standardized effect size was .45, where Cohen (1988) describes an ES=.20 as small; ES=.50 as medium, and ES=.80 as large. Thus, the PRISM-NEO project positively influenced teachers' self-reported practices, moving participants toward the Constructivist end of the mathematics teaching continuum.

Table 8.
The Effects of the PRISM-NEO Project on Teachers' Self-reported Teaching Practices

	Pre-test			Post-test			t-test results
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**[t(df) =, p =]**
Self – Reported Mathematics Teaching Practices	48	4.55	.51	48	4.78	.50	t(47) = - 4.403, p<.001

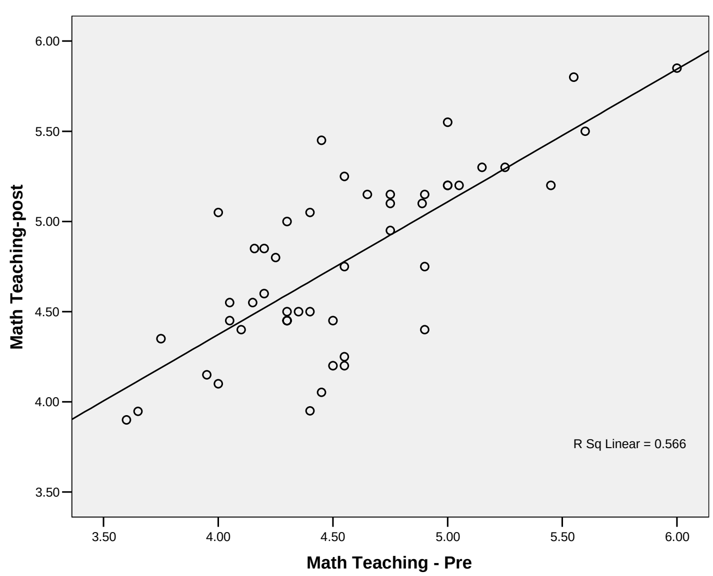
Note: The maximum mean score on the 20-item survey is 5.

A linear regression analysis was also conducted to evaluate the prediction of the post-test teaching practice scores from the pre-test teaching practice scores. The scatter plot for the two variables, as shown in Figure 1 below, indicates that pre-test and post-test teaching practice scores, are linearly related such that as pre-test teaching practice scores increase the post-test teaching practice scores increase. The regression equation for predicting the post-test teaching practice scores is

Post-test Teaching Practice Scores = 0.74 Pre-test Teaching Practice Scores + 1.43

Thus, it can be concluded that pre-test teaching practice scores strongly predict post-test teaching practice scores in this sample population. The correlation between the pre-test and post-test scores was .75. Approximately 57% (r^2 = .566) of the variance of the post-test teaching practice scores was accounted for by the linear relationship with the pre-test teaching practice scores.

Figure 1.
Pre-test Teaching Practice Scores as an Indicator of Post-test Teaching Practice Scores



Specific information about teachers' beliefs and practices was obtained through further analysis of the 20-item Attitudes and Beliefs survey. The participants' responses provided information regarding beliefs and practices in terms of the Ten Dimensions of mathematics reform (Ross, 2003). Of interest to the PRISM-NEO project were the following eight dimensions: Meeting Individual Needs (D#2), Learning Environment (D#3), Student Tasks (D#4), Construction of Knowledge (D#5), Manipulatives and Technology (D#7), Students' Mathematical Communication (D#8), Assessment (D#9), and Teacher's Attitude and Comfort with Mathematics (D#10).

A paired sample t-test was conducted to evaluate the influence of the PRISM-NEO project on all Ten Dimensions, although only the eight cited in the previous paragraph were directly related to the project intervention and design. The results indicate that the PRISM-NEO project achieved positive outcomes on all Ten Dimensions. As illustrated in Table 9 below, there was an increase in all mean scores from pre-test to post-test; yet, the difference was statistically significant on only six of the Ten Dimensions: Meeting Student Needs, Learning Environment, Student Tasks, Construction of Knowledge, Manipulatives/Technology and Students' Mathematical Communication. These findings parallel the Teacher Efficacy results, which illustrated increases in teachers' beliefs about their capacity specific to: Student Engagement and Instructional Strategies. Moreover, given the PRISM-NEO project design, it is not surprising that Program Scope and Communication with Parents were non-significant, as the design did not include exploration of either parameter. However, a non-significant result for Teacher Attitude is surprising, though could be attributed to the participating teachers possessing positive attitudes and confidence in teaching mathematics upon entering the project.

Table 9.
Effects of PRISM-NEO on the Ten Dimensions of Mathematics Reform: Means, Standard Deviations, and t-tests by Test Occasion

Dimension	Pre-test			Post-test			t-test results
	N	Mean	SD	N	Mean	SD	[t(df) =, p =]
D#1: Program Scope & Planning	48	4.68	.69	48	4.77	.77	t(47) = - 1.02, p = .314
D#2: Meeting Individual Needs	45	4.40	.53	45	4.63	.53	t(44) = - 2.91, p = .006*
D#3: Learning Environment	48	4.79	.72	48	5.05	.67	t(47) = - 2.82, p = .007*
D#4: Student Tasks	46	4.29	.69	46	4.54	.58	t(45) = - 2.96, p = .005*
D#5: Constructing Knowledge	45	4.04	.81	45	4.32	.64	t(44) = - 3.24, p = .002*
D#6: Communication with Parents	48	4.35	.98	48	4.60	.85	t(47) = - 1.69, p = .098
D#7: Manipulatives & Technology	48	4.50	.85	48	4.83	.92	t(47) = - 2.34, p = .023*
D#8: Student Communication	47	4.73	.70	47	5.09	.66	t(46) = - 3.82, p < .001*
D#9: Assessment	47	4.56	.68	47	4.67	.64	t(46) = - 1.06, p = .297
D#10: Teacher Attitudes / Comfort	45	4.79	.59	45	4.91	.64	t(44) = - 1.57, p = .125

* indicates a significance of p < .05

Teachers self-reported practice scores were cross - referenced with the teacher feedback survey (Siemon, Virgona, & Corneille, 2001). The survey asked participants to indicate the degree to which they agreed or disagreed with twelve statements specific to the impact of their involvement in the PRISM-NEO project on their teaching, knowledge of students' at-risk and plans with respect to the Nelson PRIME materials. Aggregated percentages, summarizing the degree to which participants agreed or disagreed with each statement, are shown in the shaded cells (N = 65).

Table 10:
Effects of PRISM-NEO on Teacher Practice and Knowledge Development

	SD	D	?	A	SA
Involvement in the PRISM Project has made me more aware of my classroom practices.	0	3	8	34	55
	3%			**89%**	
I am unlikely to change my assessment practices as a result of my involvement in the PRISM Project.	26	43	17	11	3
	69%			**14%**	
My classroom practice has changed for the positive. I believe I am doing a better job now than I was at this time last year.	0	3	18	46	32
	3%			**78%**	
My knowledge of Assessment and Assessment strategies have increased as a result of my involvement in the PRISM Project.	0	14	14	52	20
	14%			**72%**	
My knowledge of students at – risk and what is involved in teaching these students has increased as a result of my involvement in the PRISM Project.	0	5	9	45	42
	5%			**87%**	
My knowledge of Geometer's Sketchpad and how it can be utilized in the learning and teaching of mathematics has increased as a result of my involvement in the PRISM Project.	8	17	26	28	22
	25%			**50%**	
I am less likely to work as a part of a Learning Community. I am not convinced it adds any value to what I would otherwise do on my own.	57	29	9	5	0
	86%			**5%**	
I now have a better understanding of the nature of student learning difficulties than I had at this time last year.	2	6	17	42	34
	8%			**76%**	
It is simply too difficult to cater for the full range of individual differences in my mathematics classes.	19	44	20	16	2
	63%			**18%**	
I am unlikely to change much of what I do. I will continue to use the resources and approaches I have used in the past.	33	55	5	8	0
	88%			**8%**	
I intend to continue to use the Nelson 'PRIME' materials as a part of my assessment strategies from now on.	0	5	22	54	20
	5%			**74%**	
I intend to use the Nelson 'PRIME' materials to help me differentiate instruction in my mathematics classes.	0	5	26	38	31
	5%			**69%**	

Data from the teacher feedback survey supports findings from the previous analysis, suggesting that an overwhelming majority of the PRISM-NEO participants were positively affected as a direct result of their involvement in the project. Specifically, most participants indicated both increased awareness of their own mathematics practices and a desire to change practices in order to improve student learning. Most participants also reported improvement in their knowledge of both students at-risk and mathematics assessment strategies. Finally, the vast majority indicated strong support for the implementation of professional learning communities, and the power of teacher collaboration. Data analysis of the final teacher survey highlights six categories of influence: Professional Learning Communities, Mathematics Teaching Practices, Students at-risk, Assessment, Nelson PRIME materials and Geometer's Sketchpad influence.

Professional Learning Communities

An overwhelming majority (86%) of the PRISM-NEO teachers agreed that they would continue to participate in PLCs if given the opportunity. The teachers believed that the PLCs added value to their professional development experience. This finding is not surprising given the current research on the influence of professional learning communities or communities of practice on teacher change and capacity building, in general (Cochran-Smith, 1999; DuFour, & Eaker, 1998; DuFour, Eaker, & DuFour, 2005; Fullan, 2001; Lachance, 2003; Seashore Louis, 1998; Wenger, 1998) or mathematics teacher development more specifically (Lachance, 2003; Nickerson, 2005).

The PRISM-NEO PLC design contributed to the positive feedback with respect to this component of the project. Specifically, we encouraged each board to organize their PLCs to support both within school and within board communities. This format allowed teachers to learn and work together in their own teaching context, as well as address issues and challenges that were relevant and specific to their school/board situation. Fullan (2001) highlights the significance impact of such design, stating,

> "Learning in the setting where you work, or learning in context, is the learning with the greatest payoff because it is more specific (customized to the situation) and because it is social (involves the group). Learning in context is developing leadership and improving the organization as you go. Such learning changes the individual and the context simultaneously." (p. 126)

Mathematics Teaching Practices

Most PRISM-NEO participants (89%) reported a developed awareness of their classroom practice. This finding supports the results from the 20-item survey, which indicated that the mean for post-test teaching practice was significantly greater than the mean for pre-test teaching practice. Thus, there was a statistically significant increase in teachers' self-reported practices. The final survey results confirm the positive influence of the PRISM-NEO project on teachers' reported practices.

However, the rate at which teachers reported integration of change in their practice was not consistent. Specifically, 78% indicated an immediate positive change in existing practices, while 88% indicated a strong likelihood that they would change the resources and teaching approaches they had generally used in the past. This finding implies that some participants have quickly embraced teaching practices more aligned with reform ideals, while others are in the beginning stages of recognizing that change is required, but have yet to fully embrace implementing changes within their current mathematics teaching practice. This finding is significant, as the change process is "rife with anxiety, stress, and ambiguity" (Fullan, 2001, p. 71) and requires "considerable effort and energy to break from old habits and to begin to act in new ways" (DuFour, Eaker, & DuFour, 2005). Thus substantial time and support are necessary for those involved in the change process. However, recognition that change is required and a willingness to move toward change are significant outcomes for the teacher participants in this project.

Students At-risk

Given the focus of the project, it is not surprising that 87% of the participants indicated improvement in both their knowledge of at-risk students and knowledge of appropriate teaching practices. This supports findings from the paired sample t-test of teacher efficacy, whereby two measures of efficacy: Student Engagement and Instructional Strategies were significantly improved as a result of participation in the PRISM-NEO project.

However, 25% of the participants also indicated that they continue to struggle with understanding the nature of student learning difficulties; while 38% are either undecided or agree that catering to students' individual needs is too complex a task for teachers. These findings indicate the need for additional support and training for teachers. Specifically, teachers require fundamental information and explicit instruction regarding learning exceptionalities and learning difficulties in mathematics. Additionally, support is necessary as teachers work toward developing their understanding of differentiated instruction and then work toward implementing differentiated mathematics practices to meet the needs of all students.

Teachers require experience, time and the necessary supports as they begin to embrace the philosophy that the fundamental purpose of schools is student learning, which includes the learning of students identified as "at-risk". DuFour, Eaker and DuFour (2005) emphasize that as teachers begin to assume this philosophy of education, "they begin to recognize that some students will require additional time and support, in order to be successful, and they develop processes for providing that time and support during the school day on a timely, directive, and systematic basis" (DuFour, Eaker & DuFour, 2005).

Assessment

Although the PRISM-NEO participants indicated positive outcomes with respect to teaching practices, the data also indicates that many of the participants struggle with the development and utilization of differentiated or alternative assessment practices. Specifically, although 72% indicated that their knowledge of assessment and assessment strategies had increased, only 69% indicated intentions for modifying current assessment practices (which, based on the qualitative data analysis, are largely traditional, pencil-paper, closed ended assessment tasks). However, with 74% of the participants indicating that they intend to continue to utilize the Nelson PRIME materials as a component of their assessment strategies, there is a possibility that teachers' assessment practices will continue to move toward less traditional forms, particularly if they continue to work within the professional learning communities established during the PRISM-NEO project. However, the findings indicate a need for additional teacher support in the area of mathematics assessment, particularly for students identified as at-risk. Although the participants are moving toward reform oriented mathematics practices, their assessment strategies remain in the more traditional domain. This could be the result of embracing traditional beliefs with respect to mathematics and assessment. However, based on the teaching practice scores and teacher efficacy data discussed earlier, a more probable supposition would be the absence of adequate information and support for teachers as they develop their understanding of differentiated assessment.

Thus, it is essential to endorse within school and within board PLCs focusing on the development and implementation of differentiated assessment, with a foundation in a mathematics developmental continuum, such as Nelson PRIME. Through encouraging open dialogue between teachers about assessment results, teachers will be better "able to assist each other in addressing areas of concern" (DuFour, Eaker & DuFour, 2005) and move toward a vision of "assessment for learning" as opposed to exclusively "assessment of learning".

Nelson PRIME

The data suggests that the Nelson PRIME materials were positively received by the participants, with 75% intending to continue their use as a component of their assessment strategies; while 69% intend to use the materials to assist in the differentiation of their instructional practices. However, a significant percentage of the participants were ambivalent about the Nelson PRIME materials and their potential use in the classroom. Specifically, 27% of the participants were either undecided or disagreed with the statement concerning their future use of the materials for assessment purposes; while 31% were either undecided or did not plan to use the PRIME materials to assist in the differentiation of mathematics practices.

Based on this data, future adaptation of Nelson PRIME materials within each of the participating PRISM-NEO school boards seems unclear. Specifically, although a project participant may have found the material to be of assistance in assessment or differentiating instruction, s/he may not continue to utilize the materials if there is insufficient collaboration within the board or school to support his/her efforts. Alternatively, there may not exist a critical mass of participants within a given board or school that plan to continue using PRIME, thus the initiative may lose momentum and simply become another binder that sits on the shelves of the classroom.

It should be noted that based on more recent qualitative data obtained in February and March 2006, five of the participating ten PRISM-NEO school boards have established plans for continued use of PRIME and extensive training of various levels of teachers in their boards. The specific plans will be discussed further in the qualitative data analysis section to follow.

Geometer's Sketchpad Influence

The data concerning the influence of Geometer's Sketchpad on teacher knowledge and practice is varied. Fifty percent (50%) of the participants stated that their knowledge of GSP has increased, while 25% indicated that their knowledge was unchanged or not influenced. Similar to the Nelson PRIME materials, a large percentage of the teacher participants (26%) were undecided concerning their learning with respect to GSP. This ambivalence can be explained as a product of timing in data collection and distribution of the completed CD. Specifically, feedback from teacher participants was collected in December 2005 or January 2006, too soon to obtain accurate information, as many teachers had only received the GSP CD, three weeks prior. If this question was to be asked now, five months later, I am confident that the participants' responses would be considerably more positive. Additional time to learn, explore and utilize GSP and the newly developed PRISM-NEO GSP sketches is essential in order to obtain more accurate data concerning the ultimate impact of this component of the project on the teacher knowledge and practice.

Influence of the PRISM-NEO project on Teacher Outcomes: A Qualitative Perspective

Qualitative data provides an alternative perspective of the project's influence on teachers' sense of efficacy, teacher beliefs and practices. The qualitative data serves as a means to triangulate the findings and thus, support for the initial quantitative analysis. Interpretations of the qualitative data were guided by the research questions and the quantitative data analyses. The data was analyzed systematically (Strauss & Corbin, 1990; (Miles, 1994) using constant comparative methodology with triangulation over time, data sources (e.g., surveys, observations, written and verbal feedback, and focus group interviews) and respondents across the ten school boards. The qualitative data analysis software (ATLAS.ti) was used to process data, create and manage codes, categorize segments of data, analyze and interpret codes and quotations through searching for common words, phrases and themes throughout the data sources. The generative nature of the surveys and interview questions allowed for synthesis of the data through examining patterns that emerged across data sources.

Influence on Teacher Efficacy and Teacher Practices

As highlighted in the quantitative data analysis, the PRISM-NEO project had a significant effect on teachers' beliefs about their capacity (Teacher Efficacy). Specifically, due to participation in the project, the teachers are, generally, more confident in their abilities to engage all students in the learning process (Student Engagement) and to design and implement a variety of instructional strategies that meet the needs of their students (Instructional Strategies).

The qualitative data analysis supports these findings. Specifically, the teachers' indicated that they were now more confident in their abilities to develop tasks that engage all learners; and they were more aware of alternative instructional strategies, particularly with an increased focus on manipulative use. The teachers acknowledge that this confidence was nurtured through the structure of the PRISM-NEO project. A board administrators and Math Lead comment on the general changes they have observed in their teacher participants:

> "Teachers feel more confident in teaching mathematics using a variety of techniques and manipulatives. This has come from the hands on demonstrations, the background and strategies book and the time spent in our professional learning community in which we can "play" just as the students need to, so that we are comfortable enough to try something new in our classrooms." (B06-T02).

> "Teachers are talking a lot about ways that their instruction is changing and they are starting to share with others some of the ideas that have been coming out over the life of the project. Teachers seem to be more interested in meeting the needs of the struggling students than avoiding or blaming." (B01-T01).

While another administrator comments specifically about a teacher that has made substantive changes to his teaching practice and pedagogic beliefs:

> "One member … [now] realizes that teaching mathematics is more than teaching the curriculum, more than teaching to a textbook. Teaching mathematics is about understanding 'how' to teach math. The open ended questions and strategies to teach concepts so that at-risk students can realize success in math is essential. Mathematics presented in a meaningful manner, together with purposeful teaching is critical. This member felt confident about trying new strategies in mathematics, and did so with good results." (B04-T05).

The teacher participants described shifting perspectives in their understanding of how to engage students through modifying their instructional strategies. To a great extent, the teachers focused on introducing manipulatives as a primary component of instruction for both their students at-risk and their regular classroom students. For some teachers this process was more arduous, as it required realignment of beliefs and practices. One teacher describes her practice:

> "One thing I'm trying to do is introduce lessons using manipulatives. For example, I'm starting Geometry, and instead of talking about 3-D solids, I can use a geometric cube or interlocking cubes, and the students can start drawing the cube right away on isometric dot paper. So they get the idea of how to draw 3-D cubes. I'm trying to incorporate that into everything I do. Before we'd just open the textbook and talk about the qualities of 3-Dimensional shapes and have them write down things that are 3-Dimensional. So just paper and pencil." (B01-T09).

For other teachers, further along the math reform continuum, the modifications to their practice are realizations of how they can continue to move along the continuum. One teacher asserts, "What I'm noticing is I'm using a lot more manipulatives, and I'm using them in ways that I never used them before" (B01-T16).

In addition to the identifying the centrality of manipulatives, participants indicated that changes in their instructional practices were largely influenced by their new understanding of how students learn mathematics. The Nelson PRIME developmental continuum was highlighted as their primary source of information for modifying their instructional practices. A Math Lead asserts that the PRIME materials provided teachers with an instrument that enables them to "pinpoint [student] problems along a continuum … [and then] discern whether the concepts are understood or not. PRIME give teachers 'do-able' ideas to help kids. The materials also expanded the 'tools' in their 'tool box', giving teachers additional strategies to try" (B08-T02).

Teachers reaffirm the pragmatic influence of the PRIME materials on their teaching practice, specific to their students at-risk and their regular classroom students. They emphasize:

> "I have the continuum on the chalkboard.… I'll back up a couple of levels if a student is having trouble with a concept and have a look at where I might start with instruction to get them up to where they need to be." (B02-T12).

> "I think this is an amazing way to be able to assist teachers in finding out what skills students are missing and to be able to look at on a continuum and say: This is where they are. This is where we need to go from here. This is what they are missing." (B08-T07).

> "We also found that the diagnostic tools revealed similar gaps in understanding for all of the students tested. This helped us target instruction in certain areas for the whole group as well as in other areas just for at-risk students." (B10-T01).

However, for many teachers, the PRIME continuum and materials provided more than an exceptional new resource, it provided them with a means to reflect upon their teaching practice and engage in learning about mathematics pedagogy and the developmental learning phases of their students.

> "It makes me look at [teaching] in a different way and say: Okay, Let's make sure that they understand what they are doing so … they'll have a foundation to work from. It reinforces developmental math." (B02-T19).

> “Now that I have an understanding of the PRIME phases … I [realize students] don’t see numbers the way I see them … and it’s good to be able to recognize that. When I am thinking about multiples of ten, or I multiply in my head … I knew a lot of them don’t have the basic skills, but, I didn’t realize how in the dark they were. That’s where it is really helping. Now we can go back and say: What does this actually represent? What does this number mean? How big is it? How small is it? You can ask those kinds of questions a bit more with the phases and the books.” (B02-T07).

> “By looking at the phases I know it helps my judgment. I can tell from the research that’s been done that it is going to help me to judge where my students are and so I can pick up from that point and bring them up to level.” (B06-T07).

However, a Special Education Resource Teacher eloquently summarizes the inextricable connection between teacher efficacy, teaching practices and student attitudes, stating, “If the teachers are confident in their job, then it has to transfer over to the kids. If the kids are confident, we know we are doing our job. I think that makes everyone successful” (B01-T13).

Influence on Mathematics Content and Pedagogical Content Knowledge

The majority of the participants did not cite changes in mathematics content knowledge as an outcome of the project. However, two teachers acknowledged how improvement in their mathematics content knowledge has influenced their teaching practice.

> “I learned about adjacent angles. When it came to teaching that, I didn’t know what it was … and actually learn it myself. Now I’m finding that I’m not only learning that particular concept but I’m also trying to figure out different ways of explaining it and different ways of teaching it, because I don’t want to be the math teacher that stands up there and says: That’s just the way it is … end of story. I want to be able to say: This is why and here are different examples in your life where [that could] makes sense to you.” (B01-T16).

> “I never understood, I just knew the rules. And now you can see it. So we are now tapping into our right brain. Before we were all left brained math people. Now we are right brained math people. … I was always good with numbers, and [but didn’t really know what they meant]. For example, two years ago I realized what Pi actually was; I thought it was this magic number. … I’m [amazed with] all this stuff. It isn’t just following rules. It’s helped me a lot.” (B02-T07).

Although most participants did not acknowledged changes in their mathematical content knowledge, the majority of teachers, administrators and even Mathematics Curriculum Leaders acknowledged changes in their understanding of how students learn mathematics. Specifically, one Math Lead explains, that he has “learned a lot about the early development of number concepts and [has] seen some promising strategies for encouraging that development.” (B01-T01)

The participating teachers also highlight changes in the pedagogical content knowledge and pedagogical beliefs as a substantive outcome of their involvement with the PRISM-NEO project.

> “During our involvement with PRISM-NEO, we realize how much we did not know about how students learn mathematics and how important it is that we know this to improve student learning.” (B10-T06)

> “Before it was always pure math …and now we see more concrete. [It is a] visual way of seeing math. Before, it was always this is what you do and I understood what it meant and what to do, but I didn’t understand how it could be represented in concrete materials until now. I find it interesting. I find a lot of the things we’re looking at interesting because we were never taught that way.” (B02-T09)

> “We found the exposure to the many mathematical ideas through the training increase our teaching knowledge of mathematics. Our mathematical thinking about teaching mathematics was broadened. (B04-T03)

Influence on Student Attitudes and Knowledge

Research shows that teachers' beliefs and knowledge have a significant influence on the quality of mathematics instruction they deliver and directly shape the knowledge and attitudes of their students. Thus, if teachers' knowledge, efficacy and beliefs begin to change, it is feasible to anticipate changes in the knowledge and attitudes of their students. This consequence was discussed in the "Student Perspective" section of this report, and is evidenced again from the teachers' perspective. The teacher participants underscored the correlation between improved student confidence and their willingness to engage in class discussions, persevere through problems and some have noted improved student attendance. One teacher maintains "that [the students] are much more excited about math and they are now willing to try things" (B08-T07). This belief is supported by others, one teacher states; "I've noticed a difference in one student in particular. He had a history of attendance problems and now he is coming to class, because I work with him. … He couldn't do it before and he was frustrated. He doesn't have that feeling as much any more. So he feels better about coming to class." (B02-T19)

Board administrators and principals also noted substantive changes in the attitudes of both students' at-risk and regular classroom students. One Curriculum Coordinator described the consequences of their lesson study initiative. She explained that, they "could see the difference it made. The kids were talking about it as they were working in their groups. It was really amazing" (B10-T06). While an elementary school principal that was actively involved in the project described the broader influence on the teachers' regular classroom students, stating,

> "The teachers' use of technology and manipulatives resulted in higher levels of understanding among the students. The students became more interested, engaged and were working at higher levels of thinking. Most note-worthy, were higher levels of problem solving and demonstration of improved skills." (B02-T05)

This reoccurring theme of manipulative use correlating with improved student understanding and confidence was the common thread connecting all participating boards. Although not a novel teaching strategy, and emphasized in recent provincial documents including TIPS, it seems to be underutilized or misunderstand by some Intermediate level teachers. For an overwhelming number of PRISM-NEO participants, their recognition of the consequence of concrete materials on student learning and attitudes was substantive. Stated most simply by one teacher, "through using manipulatives, [the students realized], "Hey, I can do this!" (B03-T06) This sentiment was shared by others:

> "[In particular] it helped one student with her confidence level, because at one point she said: 'I get it'. She understood that she could do it. And before [she always said]: 'I can't do it'. But now, she can. Working with the manipulatives gave her a chance to see and make connections. Seeing how well the manipulatives worked with her, I can't wait to use more of them [with all my students]." (B02-T21)

> "I had students that were so interested in [the manipulatives]. They were more confident when they used them. [Problems] they normally wouldn't do very well, they could do with the manipulatives. I could sense confidence they didn't have with the [abstract] algebra." (B02-T09)

As the participants modified their teaching practices, they developed their pedagogical knowledge specific to students at-risk. They also began to recognize particular teaching strategies and learning environments that seemed to have the greatest influence on their students' attitude and knowledge. In addition to the pervasive use of concrete materials, the teachers emphasized the significance of working with students, one-on-one or in a small homogenous group, to target instruction on the development of requisite knowledge and skills. Moreover, the teachers reiterated the importance of connecting mathematics to real-life situations.

> "… when you have students that are missing basic skills. You're able to model how you do things and go back to using the base ten blocks. It's amazing how quickly they can make sense of it. That [concept was] perhaps the one thing that was holding them back in other areas." (B08-T07).

> "[I am amazed] how they grasp concepts and how quickly they actually get it. You [just need to] take the time to sit with them, one-on-one or even in small groups. It's sad that we can't do that all of the time." (B01-T16)

> "I was surprised by one student who is seemingly lost most of the time in math class. In the small group sessions, he really bloomed. He demonstrated he had some knowledge of fractions and how to apply these concepts in real-world examples. In all honesty, it was an exceptional experience to work with students in a one-on-one setting." (B02-T14)

> "If we actually apply the math to where we are going to use it, they can actually see what they are doing. So if we are going to teach math, let's try and find out where they are going to use it, and teach to that! Try to take them to the next step, and then see how far they will go." (B01-T07)

Geometer's Sketchpad

Timing and logistical difficulties did not allow for significant data to be obtained concerning the influence of the PRISM-NEO GSP sketches on the learning of students at-risk. However, preliminary data was obtained from teacher participants concerning their initial experiences with the program and related sketches. Only three teachers referenced using the program with their students. A high school teacher speaks positively to his experience stating, "I taught scale using GSP and the students loved it" (B03-T05). While the other teachers to reference the CD were Grade 7 – 8 teachers. Both teachers acknowledged their trepidation with the technology, yet contend that their confidence is improving. For example, one teacher states, "when I opened the CD, there's so much on there that I didn't know … BUT, I'm learning as we go along (B01-T13). Similarly, her colleague admits that she is "little more confident. I'm not afraid to use Geometer's Sketchpad. I can get it up and running. I'm not afraid to do it." (B02-T21)

However, one of the Board Leads on the project offers an alternative perspective. She recognizes the larger scale implications of the PRISM-NEO CD development at a provincial level. She contends that this component of the project offers sustainability beyond the ten boards involved in the PRISM-NEO project. She asserts:

> "During the summer [of 2005], a group of educators met to develop the PRISM-NEO GSP sketches. This was an effective way to develop expertise with the software and become part of a "provincial" PLC. By meeting to develop a product, teachers had an opportunity for personal growth. This is another PLC model that was used in the project." (B02-T01)

Summary of Findings: From the Teachers' Perspective

The qualitative data analysis supports findings from the quantitative data analysis, reiterating the positive influence of the PRISM-NEO project on teacher efficacy, teacher beliefs and teaching practices. The findings indicate that short-term, concentrated professional development can lead to teacher change and, in turn, improved student knowledge and attitudes. Moreover, the analysis of the teacher data directly relates to the analysis of the students' data. It is evident that the PRISM-NEO teachers and their students maintain similar beliefs with respect to teaching and learning mathematics. Specifically, the findings from both groups suggest that students at-risk in mathematics would benefit from additional instructional time; one-on-one or small group assistance targeted to specific requisite skills; and non-traditional manipulative-based activities focused on real-life connections.

Factors Supporting and Inhibiting Efforts to Improve Student Learning

The final research question in this study was to address specific factors that teachers and administrators identified as inhibiting or supporting their individual and collective efforts to improve mathematics instruction for all students. Although some of the comments reference the PRISM-NEO project, they are generalizable to supports and challenges beyond the project.

The themes to emerge as supportive factors in efforts to improve student learning were all human resources: Professional Learning Communities and Collegial support, Administrative support and involvement, and Government support (e.g., Ministry of Education, CODE). The two factors identified as inhibiting efforts to improve learning were Time constraints and the Absence of Mathematics Curriculum Leadership.

Factors Supporting Efforts to Improve Student Learning

Given the research on the significance of social learning theory and the influence of collegial support on teacher change, it is not surprising that the vast majority of the PRISM-NEO participants highlighted PLCs as the primary factor supporting their change efforts. The participants highlighted their board level PLCs as venues for open dialogue, to discuss successes and frustrations. The PLCs allowed participants to share ideas and resources; and to develop their collective knowledge and efficacy concerning mathematics, pedagogy and their students at-risk. However, many participants also identified the larger North Eastern Ontario PLC that begun to develop as a direct result of the multiple PRIME training sessions which all board participants attended. This was an unexpected positive outcome of the project. The following is a small sampling of the participants' responses to the establishment of the PRISM-NEO PLCs:

> "The PLCs are a good way to provide the necessary support to teachers as they learn new ways to teach/remediate in mathematics. Sharing the tasks involved in new learning relieves some of the anxiety; and communicating with colleagues provides opportunities to share information." (B08-T02)

> "I think that professional learning communities are so beneficial. That's one thing that I feel this project has done. [It has brought] people together, and not all of them have the same passion for math, but we all have the same directive to figure out what it is that we are not doing and help improve our teaching practice. With PRISM-NEO coming together with all of those different people and joining together in this learning community, I find that I get a lot out of it. The PRIME materials are great. But, even better, is the physical contact with other educators; building ideas through face-to-face learning communities. A lot of what we have learned from the different math learning communities, we've been able to share with our PLC group and with teachers in our schools>" (B08-T07)

> "… to do this with teachers from the community right across North Eastern Ontario … To have an opportunity to sit down and share at that level. I loved that the grade 7, 8, 9, and 10 teachers were sitting in the same room because this is an anomaly in Ontario." (B02-T12)

However, there is also apprehension concerning the sustainability of the PLCs beyond the life of the project. A teacher expresses her concerns, "I'm afraid that the project will just end and they'll be no follow up. Getting together to share ideas with the other teachers was an invaluable experience. I hope that something like that will continue" (B02-T20). Unfortunately, this teacher's fear could become reality if there is inadequate administrative support and involvement. However, as one administrator attests; with appropriate support "professional learning communities will continue forever." (B05-T02)

Administrative support, at all levels, was identified as an essential element to improving student learning. Although Principal's support was highlighted as a significant factor for success at the school level, Mathematics Curriculum Consultants, Student Success Leaders, and Board Directors were included under the umbrella of 'essential supporting personnel'. Specifically, the participants described a supportive Principal as one that provided them with the freedom to modify teaching assignments (e.g., team teaching); willingly adjusted timetables and organized supply teachers to allow for PLC meetings, classroom observations, or attendance at PRIME training sessions; willingly developed an awareness of mathematics teaching and engaged in discussions specific to the project goals; and nurtured a vision of collaborative leadership. One Principal emphasizes the importance of encouraging "principals to let the leaders on your staff lead." (B06-T03)

Interestingly, only one participant acknowledged the presence of a Board Mathematics Lead/Consultants on the success of their mathematics program, she states, "I think she has been the glue. She has been wonderful and has us excited about this project." (B02-T11) By contrast, the boards that did not have the benefit of a Mathematics Leader highlighted this absence as a significant obstacle in their efforts to improve learning for students at-risk. The teachers explain, "There's no lead person, we're just teachers. Leadership has to come from someone higher than me … We need a Math Coordinator." (B09-T07) While Principals express similar concerns, stating "our Board doesn't have a Math/IT consultant who can be there to consult on different matters that come up with the programs, computer issues, distribution, etc." (B09-T04) Thus, it appears that the presence of supportive Mathematics leadership contributes to the collective sense of teacher efficacy, as the Leaders provide direction, knowledge and encouragement to the teachers in their boards. Whereas the absence of adequate Mathematics leadership tends to contribute to feelings of frustration, resentment and isolation among teachers and principals as they view this absence as an indication of lack of support for efforts to improve mathematics learning for students across their board.

Ultimately, efforts to improve student learning are fundamentally connected to the Ministry of Education and other government agencies. An unexpected finding from this project was the number of participants that indicated government support had a significant influence on their efforts to improve student learning in mathematics. The participants highlighted one of two government influences, either support provided specific to the PRISM-NEO project, or government support that has been provided in recent years. For example:

> The learning communities that have developed because of Ministry funding have made a huge difference in my teaching career; a huge difference in the way I teach and how open I am to new ideas. In my opinion, the Ministry is getting this right. As groups of teachers sharing ideas about how we can make things work and then coming back and discussing it. Allowing us to figure out what is working. I think that's the best use for the dollars." (B08 – T07)
>
> "We did a load of stuff starting last year thanks to Pathways for Success. We have a ton of manipulatives and many are class sets, so everyone can have their own set of manipulatives. Pathways for Success also provided many Math workshops with Trevor Brown which did so much for all of us – he is very resourceful and has so much to share." (B09-T04)

Factors Inhibiting Efforts to Improve Student Learning

The two themes to emerge as factors inhibiting efforts to improve student learning were: Time Constraints and the Absence of a board Mathematics Leadership (as discussed in the previous section).

The time constraints identified by participants were either specific to the PRISM-NEO timeline or to the general goal of teachers' efforts to improve student learning.

The project timeline was identified as too short. To exacerbate matters further, the project began in May 2005 and ended in December 2005, resulting in a two month gap when many participants were not involved in the project. Participants also reported frustrations with the timing of PRIME training sessions and the insufficient time allotted to the training. Many participants felt that the teacher training sessions should be lengthened to ensure adequate understanding of the materials. Some suggested four to five days of training were needed. Moreover, the participants argued that they did not have adequate time to dedicate to the PRISM-NEO project due to workload demands or other competing initiatives, including adaptation of the new Grade 9 and 10 mathematics curricula. Finally, the restrictive timelines only served to emphasize the geographic obstacles faced by many of the larger boards. Specifically, one administrator explains that "the timing of the project … coupled with the size of our Board and the location of our team members (Spanish, Elliot Lake, Blind River, St. Joseph's Island and Sault Saint Marie) made it very difficult to plan more PLC meetings." (B04-T03)

The general sentiment from the participants was that additional time focusing on the project would have been appreciated. One of the Math Consultant summarized the opinions of the many participants, in stating, "It seems like we just got started and the project ended. I think this project could have easily gone over a two-year period. We didn't go for a full swim; we just dipped our toes into the water." (B02-T01)

Many of the same time related frustrations identified specific to the PRISM-NEO timeline were highlighted as obstacles to improving student learning, in general. Most participants agreed with the general sentiment that, "there's so much that has to be done but there's not enough time provided to do it." (B09-T02) More specifically, the participants reported that they did not have adequate time to plan effective mathematics lessons and provide the additional remediation that their students required. Unlike the PRISM-NEO project release time is not provided for teacher collaboration or lesson planning. Thus, the participants feel as though they are constantly racing against the clock and compromising the quality of their work due to time constraints. The participants agreed that mathematics education for all struggling students is a fundamental goal of education; however they also express frustration with the time they are provided to plan effective lessons that address this goal.

Future Plans / Sustainability

The findings presented in this report indicate that the PRISM-NEO project had a substantial effect on the knowledge, beliefs and practices of the participants involved. Although this is a significant and desired outcome of the intervention, it is difficult to ascertain whether these changes will be sustainable. Thus, in an effort to respond to this query, each of the ten participating boards was asked to provide a description of future plans for continuation of any project components (e.g., Nelson PRIME, Geometer's Sketchpad, and Professional Learning Communities). As of March 2006, five of the ten boards have either begun board-wide initiatives or have commenced preparations for initiatives. As a primary component of their board plans, all boards have included PRIME training for specific groups of teachers, while three of the boards have also included additional training and support for Geometer's Sketchpad and continued collaboration through Professional Learning Communities.

The Near North District School Board intends to direct training specifically to Elementary Resource Teachers (thirty-five teachers) with the intention that these teachers would then collaborate with Junior level teachers in each school. The Math Consultant for the board, anticipates that "the diagnostic tool and developmental continuum will be of interest to the resource teachers and [could be compared to] the literacy materials they [currently] use. More importantly, we hope that the *Background and Strategies Guide* will help Resource Teachers plan and deliver targeted instruction to struggling students in collaboration with the classroom teacher."

The North Eastern Ontario School Authorities has also successfully developed an ambitious plan to train the majority of their elementary through high school teachers in thirteen schools and authorities across North Eastern Ontario. In spite of the geographic barriers, the two board facilitators trained during PRISM-NEO will “team-train” thirty-three teachers in Sudbury (a central location for the participating teachers) and then proceed to their respective geographic regions to complete the PRIME training with smaller groups of teachers by the end of this academic year. Other academic support staff contributed to this board-wide initiative through either providing PRIME training or encouraging more involvement in the project. For example, the Student Success Leader is providing PRIME training for Grades 7 – 9 teachers to be completed by June 2006; while the Elementary Coordinator has indicated that PRIME training will also be provided for Elementary teachers “in the future”.

The Huron Superior Catholic District School Board has developed a long-term plan that combines PRIME training with additional GSP in-service (specific to the PRISM-NEO CD).

Similar to the Near North DSB, it is attempting to nurture collaboration between High School Resource Teachers and LDCC teachers, through providing PRIME training with both groups. Moreover, in the fall of 2006, they intend to extend training to “a select group of Grades 7, 8 and 9 teachers” who will “pilot PRIME in their school ... with the two [PRISM-NEO] facilitators conducting the training [and then] serving as resources [for the pilot school]”. They have also established PLCs within the board’s mathematics committee in an effort to “integrate lesson sharing” and collegial support.

The Rainbow District School Board has also developed an ambitious plan to encourage sustainability of the PRISM-NEO project goals. Specifically, the board “will be purchasing one PRIME Number and Operations resource and one Leadership book for each of [their] grade 7-12 schools”. The board will be implementing “school-based” professional development next year, with the intention that the board’s Math Lead utilized the “PRIME materials during these sessions.” Beyond the PRIME training, there will be continued in-service promoting “the wealth of resources in the PRISM-NEO GSP CD.” They also plan to continue development of the “GSP resources as needs are expressed … and teachers [begin to see the capacity] of this program” in assisting their students at-risk. Finally, there are plans to include PLCs in some form within the board, beginning in the fall of 2006; however specific details have not been discussed.

Finally, the Sudbury Catholic District School Board has developed a two year plan that includes not only additional in-service for GSP, inclusion of PRIME training, and the establishment of PLCs, but plans that will effectually influence mathematics learning for all students across their board. Specifically, the board has already provided GSP in-service for all Grade 7 and 8 teachers, and installed the PRISM-NEO GSP sketches on “every school’s server in a file on the group drive so everyone can access them”. They have purchased nineteen PRIME kits (one per school) and will provide training for Principals and selected Junior Lead Teachers with the intent to “expand PRIME training to other Junior teachers and Intermediate teachers” by the fall of 2007. Beyond this specific training, the board intends to establish PLCs which will “focus on math manipulatives and other strategies to improve student understanding of mathematics in the Intermediate Division”. Finally, beginning in September 2006 the board intends to “move to 60 minutes per day of mathematics in every Grade 7 and 8 class” throughout the board.

Given the importance of providing evidence of the sustainability of this project, it is apparent that the PRISM-NEO initiative has effectually influenced not only individual participants, but has also had some influence on the direction that some North Eastern Ontario school boards will be ensuing. This is an essential outcome of the PRISM-NEO project, perhaps more significant than the findings cited in this report, as it demonstrates the collective desire to improve mathematics learning for all students.

Conclusions and Recommendations

It is evident from the analysis of both quantitative and qualitative data that teachers and students were positively influenced through involvement in the PRISM-NEO study. The intervention was generally successful in influencing teachers' conceptions of mathematics pedagogy and their teaching efficacy, specific to their at-risk student population. Thus, the findings indicate that, under specific conditions and within a supportive, collaborative environment; short-term, concentrated professional development can lead to teacher change and, in turn, improved student knowledge and attitudes.

The study findings also indicate that teachers and their students at-risk maintain similar beliefs with respect to the most effective intervention strategies for supporting the teaching and learning of mathematics for adolescent at-risk students. In particular, the findings suggest that students at-risk in mathematics would benefit from additional instructional time; one-on-one or small group assistance targeted to specific requisite skills (e.g., basic operations with whole numbers and fractions; and identifying, describing and comparing fractions/decimals); and manipulative-based activities focused on real-life connections. Moreover, the findings underscore students' understanding of their learning needs and their willingness to engage in the learning process. Finally, evidence presented in this study illustrates that at-risk students are not necessarily disengaged and disinterested learners; rather they expressed a desire to learn mathematics, and perceived it as significant and relevant to their lives and future success.

As evident in previous research, changes in teacher practices do not come easily or without the necessary supports. Findings from this study draw attention to the necessary conditions required to nurture efforts to improve learning for students identified as at-risk in mathematics. These provisions include:

1. The establishment of both in-school and in-board Professional Learning Communities specific to mathematics education;
2. Targeted in-service specific to strategies for improving mathematics learning for all students, for example, the Nelson PRIME materials;
3. Administrative Leadership committed to supporting teachers and understanding effective mathematics pedagogy (e.g., as a minimum, an understanding of the Ten Dimensions of math reform);
4. Mathematics Leadership either within the school or within the board, in sufficient numbers to address logistical limitations such as an expansive geographic region;
5. Continued Government support; and, of course;
6. Sufficient Time for active engagement in the learning process, sustained reflection on beliefs and practice, experimentation and implementation (including lesson planning) within the teaching context, and opportunities to dialogue with colleagues.

Although these six conditions encompass the "ideal" environment to nurture teacher capacity and student success, it may not be possible to address all conditions within a specific initiative. Nonetheless, as some of the PRISM-NEO boards have illustrated, it is possible to improve student learning in the absence of some of the conditions.

Additionally, although a board may have all six necessary conditions in place, this does not guarantee success. As Hargreaves asserts, "teachers as learners are at the center of educational change" (Hargreaves, 2001), p. 131), thus in the absence of willing teacher participants the initiative is bound to fail. Teachers must be willing to accept the risks and frustrations involved in the pursuit of changing teaching practices. However, it is important to note that, despite project guidelines, not all of the PRISM-NEO teachers eagerly volunteered to participate in this study. Yet, in spite of their initial apprehension and inevitable frustrations, the teachers began to learn to change as they learned through change. It was because of the supportive environment nurtured in the PLCs that teachers learned to embrace the change process and began to open themselves to developing new understandings of mathematics and mathematics pedagogy that supported all students.

In conclusion, as evidenced in this study, professional development is not a linear processes, rather it should be designed to allow participants to cycle through a reflective learning process that includes: Active engagement in targeted, math specific training (e.g., PRIME, manipulative use, GSP training) combined with purposeful dialogue with colleagues and mathematics experts; experimentation and implementation within their teaching context; reflection back on the developmental experience, possibly combined with further professional development; active reconstruction of existing beliefs in light of the new experiences; and implementation of reform mathematics teaching practices (at varying levels of reform).

The reflective learning process is cyclical in nature and thus does not have a definitive beginning or termination point. Teachers must be encouraged and supported to continuously seek new learning opportunities in their effort to improve mathematics learning for all students. I offer the final word to one of the participants who encapsulates the fundamental purpose of learning communities and professional development, stating,

> "I think that it's our job as a learning community to always be in pursuit of the ultimate learning tool and the ultimate strategies for any given child, because that's our job. And if there's not constant open and positive communication; it's just going to break down. And the ones to suffer will be the children." (B01-T16)

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Appendix: Description of the Data Collection Instruments

Quantitative Instruments:

1. The 20-item **Mathematics Teacher Attitudes and Practices Survey** was administered as a pre-test (May 2005) and post-test (December 2005) measure of the PRISM-NEO experience. Each statement on the survey requires teachers to agree or disagree using a 6-point Likert scale. Negatively worded items are reversed such that a high score on the instructional practice scale represents high fidelity implementation of mathematics teaching reform. Evidence of its validity is presented in Ross, McDougall, Hogaboam-Gray, and LeSage (2003) and in Ross, McDougall, and LeSage (2001). The survey was originally developed to probe beliefs and self-reported practices for the teaching and learning of mathematics. The twenty items on the survey tap Ten Dimensions of mathematics teaching as detailed in (Ross, 2003) (see Appendix 1). Moreover, the survey dimensions are aligned with the official Ontario Mathematics curriculum, Mathematics, Grades 1-8 (Ontario Ministry of Education and Training, 1997) and the most recent NCTM Standards (2000). In previous research, this scale has been internally consistent, a significant predictor of EQAO achievement in mathematics, and it correlates to observations of teaching.

2. A **Web Site Self-assessment** task was completed only as a pre-test, to provide a base-line measure teachers' mathematics beliefs, pedagogic beliefs and perceived teaching practices. The self-assessment instrument is based on a series of probes that directly corresponded to a rubric identifying the Ten Dimensions of mathematics reform (see Appendix 2). Each of the ten dimensions is arranged in a four-level hierarchical continuum measuring the degree of fidelity to the NCTM Standards. The overall score within each category ranges from "procedures focus" (Level 1), which corresponds to more traditional mathematics instruction, to "exploration focus" (Level 4), which corresponds to reform mathematics instructional practices. The web-based rubric provides the participants with an opportunity to consider their own teaching beliefs and practices within the framework of a research prospective. The web site can be viewed at http://www.solidcs.net/mathtls.htm

3. A modified version of Hoy and Woolfolk's (1993) **Teacher Efficacy Scale** questionnaire was utilized to measure teachers' attitudes toward teaching mathematics to students at-risk. The efficacy scale was administered both pre-test and post-test The *Teacher Efficacy* questionnaire consists of 12 items adapted for mathematics teaching from Tschannen-Moran and Wolfolk Hoy (2001): four items for *efficacy for engagement,* four items for *efficacy for teaching strategies,* and four items for *efficacy for student management* (Tschannen-Moran, 2001). Teacher efficacy measures the extent to which teachers believe they will be able to bring about student learning. It is an important outcome of in-service because teachers' with positive beliefs about their instructional capacity are more likely to try out new teaching ideas, particularly techniques that are difficult, involve risks, and require control to be shared with students.

4. A modified version of Siemon, Virgona and Corneille's (2001) Likert-style **Teacher Feedback Questionnaire** was utilized to evaluate the influence of the PRISM-NEO project on teachers' practice and knowledge. The survey asked participants to indicate the extent to which they agreed or disagreed with twelve statements specific to the impact of their involvement in the PRISM-NEO project on their mathematics teaching, their knowledge of students at-risk and their future plans with respect to the Nelson PRIME materials.

Qualitative Instruments:

1. **Observational notes** and **researcher participation** during Professional Learning Community (PLC) meetings with the three Lead Boards' family of schools throughout the duration of the project. The anecdotal notes focused primarily on:

   a) Discussion of successful practices of participating teachers.
   b) Discussion of the challenges and supports of differentiating instruction; assessment and meeting the individual needs of the student participants.
   c) Discussion of improvement in the knowledge and skills of participating students through the use of the PRIME developmental continuum and/or the GSP sketches?
   d) Identifying concepts in the PRIME continua for which students struggle and may benefit from the use of additional Geometer's Sketchpad (GSP) sketches.
   e) Discussion of the potential benefits of utilizing GSP with students at-risk; and the applicability of the developed CD for classroom and home use.

2. **Focus group interviews** with the seven smaller participating boards during the **August** Rejuvenation sessions to obtain information and feedback useful in answering the research questions and creating additional professional development experiences or directive feedback to support the smaller boards.

4. The final **focus group interview** was adapted from the Australian study: "Successful Interventions Numeracy Project - The Middle Years Numeracy Research Project: 5-9" (D. Siemon, Virgona, J., and Corneille, K., 2001). Due to geographic locations and the limitations of time, the post-test focus group interviews were conducted with only the three lead boards. The questions were designed to provide teachers with an opportunity to reflect on their teaching and learning experiences during the PRISM-NEO project; provide feedback concerning the PRIME materials and their involvement within the professional learning communities; highlight issues influencing their mathematics practice including teaching students identified as at-risk; discuss teacher effectiveness issues and identify effective strategies for continued school improvement, specifically improved student learning in mathematics; and discuss future plans for the continuation of Professional Learning Communities and/or the PRIME materials.

5. To address the logistical barriers of location and time, similar **final interview questions** were sent to the seven smaller participating boards via **electronic mail** (email). One of the two PRISM-NEO facilitators from each board was sent the interview questions, asked to obtain feedback from the other participants in their board, consolidate the feedback then forward it to the researchers electronically.

6. **Administrative feedback** was requested electronically for each of the principals involved in each family of schools within the ten participating boards. The administrators were asked to highlight their level of involvement, their form of support, and provide feedback as to their future plans for continued work with students at-risk in mathematics within their respective boards.

7. **Student achievement data** with respect to movement along the PRIME continua (improvement in knowledge and skills) at the beginning and end of the project timeline.

8. A **student attitude survey** was administered post-test to provide an overview of the student participants' demographics and attitudes toward mathematics and learning.

9 **Student exit interviews** were conducted by the participating teachers with their respective student participants. The interview focused on students' perceptions of change (cognitive and affective) as a result of involvement in the PRISM-NEO project. Additionally, the interviews garnered student feedback with respect to mathematics topics or concepts identified as problematic; and effective teaching strategies for students' at-risk.

10. **Classroom artefacts** were collected that demonstrated implementation of the PRIME continua. These included the PRIME diagnostic tests, intervention activities, assessment tasks, teachers' anecdotal notes, and formative feedback concerning student progress.

11. A small sample of teachers volunteered for **classroom observation** once during the project (November 2005) in each of the three lead boards in order to:
    a) Collect information concerning the implementation of the intervention.
    b) Observe the teacher's adaptations and improvisations of the intervention.